

iron procured? It has been shown that the iron lost from the muscle is insufficient to yield the iron gained by the ovaries, and it is thus probable that the hæmoglobin of the blood must be drawn on for this element. The liver does not seem to yield iron to the ovaries.

Pigments of Muscle, Ovaries, &c.—Miss Newbigin's study of the pigments of the muscle and ovaries show that two lipochromes are present. First, the very widely distributed yellow pigment, lutein; and second, a bright red lipochrome, which, mixed with the former, gives the characteristic colour to the salmon muscle and ovaries.

Though it has not been possible to investigate the source of the pigments, the evidence adduced tends to show that the characteristic red pigment is probably not derived from the food, but that it is constructed possibly out of the very widely distributed yellow pigment. Its storage in the muscles and its transference to the ovaries is demonstrated. Its fate in the male fish is still obscure, though the deeper pigmentation of the skin in the male suggests its elimination by that channel. What the purpose of the pigment is, is not clearly indicated, though it seems probable that by colouring the ova it may assist in their concealment during development.

Nature of the Transference of Material.—These observations throw important light on the nature of the transference of material. They clearly show that nothing of the nature of a degeneration in the muscle takes place. The muscles simply excrete or give out the material accumulated in them, or utilise it as a source of energy within themselves.

Source of the Energy for Muscular Work, &c.—The extent to which the fats and proteids lost from the muscles are used for the construction of the genitalia on the one hand, and for the liberation of energy on the other, varies somewhat in males and females. Taking the earlier months—to August, it is shown that in the female 12 per cent. of the fats and 3 per cent. of the proteids go to the ovaries, the rest being available for energy; while in the male about 5 per cent. of the fats and 14 per cent. of the proteids go to the testes.

The total energy liberated from fats and proteids is possibly somewhat greater in the male than in the female, being to August 1,271,000 kgms. per fish of standard length in the female, and 1,380,000 kgms. in the male. Of the energy thus liberated about 2200 kgms. are required to raise the fish to the height of the upper water of the river, the remainder being available for the much greater work of overcoming the resistance of the stream, and for internal work and for other calls upon the energy supply.

Of this total available energy in the female, about 20 per cent. is derived from the proteids, while in the male only 9 per cent. is derived from this source. The rest is derived from the fats.

Food Value of Salmon.—The food value per unit of weight of muscle deteriorates as the season advances. In each fish caught in the estuaries the food value remains almost constant, the larger size of the late-coming fish making up for the deterioration of the flesh. The food value of each fish caught in the upper waters is less than that of those caught in the estuaries, and in October and November is only about one-third that of fish caught in the river-mouth. Since the large late-coming fish contain more ova than the smaller fish, their destruction does more damage to the breeding stock.

Factors Determining Migration.—In considering the question of migration, it must be remembered that the Salmonidae are probably originally fresh-water fish, and that the majority of the family spend their whole life in fresh water. *Salmo Salar* and other allied species have apparently acquired the habit of quitting their fresh-water home for the sea in search of food, just as the frog leaves the water for the same purpose. When, on the rich marine-feeding grounds, as great a store of nourishment as the body can carry has been accumulated, the fish returns to its native fresh water, and there performs its reproductive act.

That the passage of the fish to fresh water is not governed by the growth of genitalia and by the *nisus generativus*, is shown by the fact that salmon are ascending the rivers throughout the whole year with their genitalia in all stages of development.

From May to August the fish leaving the sea have about the same amount of material stored in their muscles. During these months the ovaries are yet small, and do not act as a reservoir for stored material. In October and November the estuary fish have a smaller amount of stored material in their muscles, since the period of rapid growth of the genitalia has supervened before

the full accumulation of material in the muscles has been accomplished. This rapid growth of the genitalia would withdraw material, and prevent its accumulating in the muscle; and thus, when the necessary amount of stored material was accumulated, it would be distributed between these structures. The late-coming salmon, although the supply of solids in the muscles is smaller, have the ovaries so large that the total store of nutrient material in the fish is just about the same as in those entering the estuaries in the earlier months.

The state of nutrition is the factor determining migration towards the river. When the salmon has accumulated the necessary supply of material, it tends to return to its original habitat.

THE STRAMBERG CORALS.

PROGRESS in the classification of corals has been a passage from fog to fog across lucid intervals cleared by successive systems, which have collapsed under the efforts to improve them. The primeval darkness of Ellis, Guettard and Esper was first lightened in 1830 by the classification of de Blainville, which was obsolete within four years of its publication. A long series of memoirs by Edwards and Haime, begun in 1848, gradually laid the foundations of a system at once more adequate to the wide variations in coral structure, and more natural; but it was not until 1857-60 that the two authors' complete classification was published in the great "*Histoire Naturelle des Coralliaires*." The essential features of their scheme were the separation of the Palæozoic corals as the order Rugosa, and the division of the later corals into two orders, the Aporosa and Perforata, characterised respectively by a solid and a porous wall. The classification gave helpful guidance to those who chose to use it; but many authors preferred to follow de Fromentel, who in 1861 issued a more artificial but simpler system, based on the mode of association of individual corallites into compound coralla. The life of Fromentel's classification was, from its nature, necessarily brief; while that of Edwards and Haime was weak in so many points, that under the numerous amendments of Etallon, Milaschewitsch, von Zittel, and others, the original boundaries became indefinite, and the system once more involved in fog. In 1884, P. M. Duncan restored order by a revision of the genera of Neozoic corals; he adopted, in the main, the same principles as Edwards and Haime, and his revision is still the most useful handbook to coral classification. It has held this position in spite of repeated attempts to change the whole basis of classification. Thus Pratz in 1882 proposed a scheme founded on the septa; von Heider and Ortmann have advocated another, resting on the formation of the "wall"; and recently Miss Ogilvie has suggested a new arrangement, even more radical in its changes.

Miss Ogilvie's views are propounded in two great papers: one in the *Philosophical Transactions*, in which the general principles are stated; and the second, a monograph of the Stramberg Corals, in which her theories are applied in practice. The former work is already known to readers of NATURE by an explanation written by the authoress (vol. lv. p. 280, January 21, 1897), so that the general principles need not be considered here. It has been found in coral history that the best test of a theory of classification is its results. Students of the corals have always been ready to welcome any morphological light that offered guidance through the taxonomic gloom, and have preferred to judge it by the help given in practical work. We therefore turn to Miss Ogilvie's monograph to see whether her classification associates similar corals, and separates those which are unlike.

The authoress is to be congratulated on her material. The Stramberg Schichten have yielded an instructive fauna, different sections of which have been described in other parts of this work by von Zittel, Cotteau, Böhm, Moericke and Zeise. The beds occur on the boundary between the Cretaceous and Jurassic systems, and their fossils have the usual interest of a transition fauna. Miss Ogilvie has described the corals in detail and with care, and her monograph is illustrated by twelve fine large plates. It is unquestionably a most valuable and extensive addition to our knowledge of the Mesozoic corals,

1 "Die Korallen der Stramberger Schichten," by Maria M. Ogilvie, D.Sc., Palæontologische Studien über die Grenzsichten der Jura- und Kreide-Formation im Gebiete der Karpathen, Alpen und Apenninen. Part vii. Palæontographica Supplement, vol. iii. pp. 73-282, pls. vii.-xviii. (1897).

and is well worthy of a place in the series in which it is published.

The monograph has, therefore, a double interest. It makes known to us an important coral fauna, and the descriptions are arranged on a scheme which has all the attractiveness of daring and revolutionary change. The authoress distributes the Stramberg corals among 128 species and 41 genera, which are grouped into nine families. And it is by the constitution of these families that Miss Ogilvie's classification will be judged.

The first family is the *Amphiastrea*dæ, of which the typical genus *Amphiastrea* was founded by Etallon for a Kimmeridgian coral that presents some points of resemblance to the *Rugosa*. Koby has described a series of Jurassic genera allied to *Amphiastrea*. He placed them in the *Rugosa*, but made no attempt to formulate a definite family for their reception. Miss Ogilvie has now taken this step, which will probably receive unanimous approval, although whether all the eleven genera are correctly assigned to it is open to doubt. Let us take, for example, the genus *Dendrogyra*, of which the type species is the recent West Indian coral *D. cylindrus*, Ehr. We fail to see in that coral any of the primitive characters of *Amphiastrea*. *Dendrogyra* has a columella, and the corallites are separated by bands of exotheca. The new species which Miss Ogilvie refers to *Dendrogyra* has no exotheca separating the corallites, and there is no columella shown in the figures (Pl. xvi. Fig. 3, 3a, 4, 4a), although "eine Art von Saulchen" is mentioned in the description. Miss Ogilvie remarks the near affinity of *Dendrogyra* and *Euphyllia*; and if those genera be closely related to her *D. sinuosa*, then we can only conclude that the fossil is no special ally of *Amphiastrea*.

The next family is the *Turbinolidæ*, represented by the genera *Epismilia* and *Pleurosmilia*. Of the former Miss Ogilvie has seen six Stramberg specimens, which are referred to three species. Both the genera are transferred to the *Turbinolidæ* from the very original view, that a diminished development of endotheca goes on *pari passu* with a stronger development of "wall." Miss Ogilvie retains throughout von Heider's terms *Eutheca* and *Pseudotheca*, and this family illustrates the difficulties they occasion; thus it is stated (p. 134) that the subfamily *Trochosmilinæ* have "æchte theca vorhanden," whereas *Epismilia*, the second genus placed in it, is stated (p. 141) to have a "Pseudotheca." The retention of *Epismilia* is a step of doubtful value, for there seems good reason to regard the genus as founded only on a worn, weathered *Montlivaltia*. But according to Miss Ogilvie's scheme *Epismilia* and *Montlivaltia* are placed far apart, and separated, in fact, by four families. One of the intermediate families is the *Pocilloporidæ*, the most novel feature in which is the inclusion there of the genus *Stephanocania*. *Pocillopora* has well developed tabuli, rudimentary septa, no pali, and massive cœnenchyma. *Stephanocania*, on the other hand, has no tabuli, well-developed septa, exceptionally distinct pali, and there is often no cœnenchyma or exotheca between the corallites. Miss Ogilvie may perhaps be using the name *Stephanocania* in some new sense; for she elsewhere remarks, "it is doubtful whether they [*Astrocania* and *Stephanocania*] are represented in recent seas" (*Phil. Trans.*, vol. 187, p. 307). But *Stephanocania* was founded on the common living West Indian coral *S. intersepta*.

The next family is the *Madreporidæ* represented only by *Thamnarea*. In the corals of that genus the septa are palisades of irregular, separate, vertical rods, connected by horizontal, synaptical platforms. Miss Ogilvie describes the septa of *Madreporidæ* as "bilaterally or radially arranged, compact; sometimes represented by a series of horizontal spines projecting inwards from the wall." If *Thamnarea* is to be retained in the *Madreporidæ* the family characters must be changed. *Thamnarea* appears to represent one of the extreme types of the septal structure seen in the genus *Microsolena*, which Miss Ogilvie leaves in the *Fungidæ*. To separate *Thamnarea* from *Microsolena*, and ally it to the compact-septum *Madrepora* is one of the changes which prejudices the principles upon which the proposal is based.

It may be objected that these criticisms are mere details. But it is by such details that works as the present can best be tested. There is no need here to rediscuss the principles, as that has been previously done by Bourne and Bernard. The value of the present work is that it gives us a chance of examining the results to which the principles lead. Although

the results may not all be accepted, students of the *Madreporaria* will be grateful to Miss Ogilvie for this solid addition to the mass of knowledge of Mesozoic corals. Her reshuffling of the genera is useful and suggestive, for it brings together corals usually placed at the opposite ends of the group, and renders necessary the close comparison of genera which otherwise no one would have thought of comparing. Thus the work is of value not only as the description of many new and interesting corals, but as it leads to the re-examination of forms previously known from a fresh point of view, a labour which is always profitable.

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UNIVERSITY EDUCATION.¹

THE Johns Hopkins University, which has done me the honour to ask me to say a few words on this occasion, is, although already distinguished, a new and young university. I can remember well its beginning, and as Dr. Gilman has hinted, I may claim to have taken some small part in its birth. When I moved in 1870 from London to Cambridge, I took with me a bright lad of whose ability and industry I had already taken notice. At Cambridge he became my right-hand man, and I had some hopes that I should long have his help; but President Gilman appeared upon the scene, and his influence was so strong that I felt that my own interests were not to be considered, and that I ought to send that favourite across the waters to occupy the first chair of Biology in this new university. Although the memories of him whom I need scarcely name, Henry Newell Martin, are tinged with melancholy, still I feel that this university must always look back with pride and affection on the work which he has done in this country, and in this affection and pride I claim a small share for myself.

Your university is a new one. I come from a very old one; one which was founded six hundred years ago, which has lived through all those centuries, and which, though it has some of the charms, has also some of the evils of antiquity. The traditions of the past weigh heavy upon us. When we attempt to stretch our limbs to meet the new needs of new times we find some old written law, some well-established prejudice, some vested interest preventing our full development. You are a new university; and although I have purposely refrained from refreshing my mind as to the exact status of your regulations, and as to how far you may have already entangled yourselves in the toils of enactments, still I will take it for granted that you differ from us in the freedom with which you can move forward towards the needs of the coming times; and I think perhaps I could not do better at the present moment than to use the opportunity offered me to take my old university as a text, and to draw from it and its history some few plain reflections which I hope may be practical and useful with regard to the conduct of universities. Although I understand that I have been especially invited by the medical faculty, I will take leave to treat only of general things, since the welfare of the medical faculty is bound up in that of the whole university.

The morphologists tell us we can learn much by studying the embryo, and something perhaps may be learned by looking back at this old University of Cambridge in the days of long ago—in the days when it too was a relatively young university. Things were very different then from what they are now. The dimly lighted streets or alleys in which the students lived were an emblem of the whole university. There was little outward show of glory then; there were no beautiful buildings, few books, and each student's duty was, in part, to listen to the lecture, to the reading of something which was written, but which he could not see with his own eyes. In spite of all these difficulties there were certain features of the university of that time which I trust I may say have been, with some little wavering here and there, maintained since, and which I cannot help thinking have contributed in very large measure to make it what I may venture to call it, a famous and great university.

One of the most striking features of the attitude of both students and teachers at that early time was that they recognised in the training of the university a preparation for practical life. There were at that time three main occupations in which learning was of practical use; and in correspondence to those three occupations there were established the three great faculties of the

¹ Address delivered at the Johns Hopkins University, Baltimore, October 11, 1897, by Dr. Michael Foster, Sec.R.S. (Reprinted from the *Bulletin of the Johns Hopkins Hospital April*.